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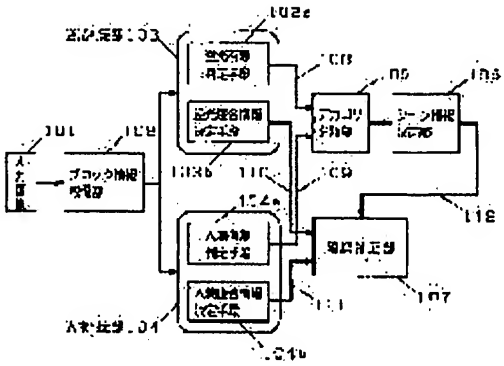
(54) GRADATION CORRECTING DEVICE

(57)Abstract:

PURPOSE: To judge reliability with which an input image is backlight scene and a backlight degree in a backlight scene by a picture processing and simultaneously to judge reliability with which an input image is figure photographing scene and a figure degree in order to achieve highly precise discrimination process for forming an optimum gradation correcting curve by judging an input image to make a video-print having a backlight condition or non-beautiful skin color of a person higher image quality.



CONSTITUTION: A backlight judging part 103 judges backlight from brightness and shape of a dark part by blocking and binarizing the image and calculates backlight degree from estimation of face brightness of the person. A person judging part 104 judges the presence of the person from chromaticity and brightness of skin color and calculates pereon degree from skin color brightness. Reliability of a scene characteristic is calculated from the backlight judging part 103, the figure judging part 104, a category classifying part 105 and a scene information deciding part 106 and the gradation correcting of the optimum picture is performed by inputting these pieces of information into a gradation correcting part 107. Consequently, an image judging result with higher precision hereto can be obtained and optimum gradation correcting to the image is attained.

LEGAL STATUS

* NOTICES *

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2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the gradation compensator for high-definition-izing of images, such as a video printer.
[0002]
[Description of the Prior Art] The image and image printed with a video printer have many which amateur photoed with the home movie camera. If the person is a backlight scene in many cases and it prints as it is in order that the image photoed outdoors in the daytime may not have the lighting of an exclusive video light etc., a person's face will be reproduced darkly. So, when it judges that an input image is a backlight scene and is judged with a backlight, the technique which increases the brightness and saturation of an image and reproduces a dark face beautifully is required. Moreover, in the person photography scene of a face rise of a person, the technique which changes into the thing which had especially beige gradation adjusted, and reproduces more beautiful flesh color is also important. In this case, the technique of a person judging is needed.
[0003] In the Prior art of a backlight scene judging, there are two kinds of what chooses a gradation curve the optimal and carries out gradation amendment about what controls automatically the iris which controls exposure optimally so that it may be carried in a video camera and a photographic subject may not become dark with a central important photometry (JP,5-122600,A), and the image which deteriorated (JP,3-106269,A). However, all have calculated and judged the brightness ratio of the center section of the screen, and the whole in a backlight scene judging. The description is considered that a photographic subject always exists in that the average luminance of a photographic subject is equivalent to the degree of a backlight, then the point of having set the assumption to say, in the center of a screen. There are some (JP,4-340875,A) which carry out block division of the screen as what gave the degree of freedom a little to the photographic subject location, and find main photographic subjects by correlation with the luminance distribution within a middle-of-the-screen section block, and in case it asks for the average luminance of a photographic subject with a special division photometry of a screen, there are some (JP,5-122600,A) which lose the effect of the dress of the bright color which wears the photographic subject, or a dark color etc.
[0004] On the other hand, although the Prior art in a person judging has a thing (JP,4-346334,A) using image field division etc. with the two-dimensional histogram of what detects the hue near beige (JP,4-23592,A), a hue, and saturation, all determined the field appropriate for [in chromaticity Hiranai] flesh color, and it has processed and judged them only with the chromaticity.
[0005]
[Problem(s) to be Solved by the Invention] Conventionally, since it was based on the premise that a photographic subject exists in middle of the screen in a backlight judging, when the photographic subject inclined toward right and left on the screen, or when two persons' photographic subject had dissociated, the technical problem to which a backlight judging is not carried out correctly occurred. Moreover, the technical problem to which only a background carries out the misjudgment law of the image with much black field area, such as a dark image or an image of the woman of long black hair, to a backlight occurred. Furthermore, the criteria of backlight degree count -- a backlight degree will change a lot in a black costume and white dress also in the state of the same lighting -- were ambiguous. On the other hand, in a person judging, since modeling of a person configuration is difficult, there are many techniques of taking the policy which maps the color distribution on an image to a chromaticity diagram, and detects the location where a beige probability is high with a hue and saturation. However, outdoors, a beige hue and saturation have shifted under the effect of the illumination light. Moreover, a beige chromaticity is changed by the race or makeup. Furthermore, since the color of a beige system existed in a nature without limit, it had technical problems -- superfluous

detection is carried out in the beige field in the location which cannot have a person's face originally [, such as the image lower part,] especially.

[0006] A person judging can be carried out without this invention's solving the above-mentioned conventional technical problem, and being able to carry out a backlight judging conventionally at high degree of accuracy, and being influenced of lighting, and it aims at offering the gradation compensator which can obtain the video print of the result high definition.

[0007]

[Means for Solving the Problem] With the output of the block information acquisition section which the gradation compensator of this invention carries out block division of the input image, and searches for brightness chromaticity information in order to attain this object, and said block information acquisition section For example, a description existence judging means to judge the existence of said description for every description of said input images, such as a backlight scene and a person scene, A degree information decision means by which the image processing corresponding to said description determines the brightness degree of the specific part of said input image, The categorization section which classifies said input image according to the combination of the output of each of said description existence judging means to each category, The scene information decision section which determines with what reliability said input image has said each description for said each category of every, and the gradation amendment section which performs the optimal gradation amendment for said input image according to the output of said degree information decision means and the output of said scene information decision section are provided.

[0008]

[Function] By this configuration, block division of the input image is carried out coarsely in all directions first, and a backlight judging and a person judging are carried out by processing that block information.

[0009] In a backlight judging, in order to judge a backlight scene in the configuration and brightness of dark space, without using the assumption which exists in middle of the screen, the judgment of high degree of accuracy can do a backlight photographic subject conventionally, and a value reliable since person **** is presumed and evaluated also about a backlight degree can be acquired. Moreover, in a person judging, although a beige judging is made into the keynote, based on the candidate data from a chromaticity, beige distribution was searched for by the principal-component-analysis technique including beige gradation, the approach of judging at the include angle is taken, and it can detect, without being influenced of lighting fluctuation in comparison.

[0010] Each degree and reliability are acquired from an above-mentioned backlight judging and an above-mentioned person judging, and since the optimal gradation amendment curve is generated from them and gradation amendment can be performed, even when the quality of a former image is seldom high definition, a high-definition video print can be obtained.

[0011]

[Example] Hereafter, the whole one example configuration of this invention is explained using drawing 1 . Drawing 1 is the block schematics of the gradation compensator in one example of this invention. In drawing 1 , it is the image inputted from the video printer etc., and 102 is the block information acquisition section, and 101 is an input image and it outputs [it carries out block division of the input image 101 in all directions, determines the central value in each block, and] the central value as block information. 103 is the backlight judging section and calculates the backlight existence judging 108 and the backlight degree 110 in response to said block information, respectively by backlight existence judging means 103a and backlight degree information decision means 103b. 104 is the person judging section and calculates the person existence judging 109 and the person degree 111 in response to said block information, respectively by person existence judging means 104a and person degree information decision means 104b. 105 is the categorization section and classifies an input image into one category in four categories which say to "it is not a person photography scene although it is a backlight", and the 3rd, "It is not a backlight but a person photography scene", and say to the 4th "it is the person photography scene of a backlight", and the 2nd the 1st, "It is not not a backlight but a person photography scene, either" combining two information, the backlight existence judging 108 and the person existence judging 110. 106 is the scene information decision section and determines each reliability information 112 on three descriptions of the image scene "backlight scene" -"person photography scene" - "others" required at the time of composition of the amendment curve by gradation amendment, from the selected category information. 107 is the gradation amendment section and generates a gradation amendment curve based on the reliability information 112, the backlight degree 110, and the person degree 111.

[0012] Hereafter, each block of one example of this invention is explained. First, the block information acquisition section 102 is explained. The input image 101 inputted into the block information acquisition section 102 is a full color image with which each pixel which carried out A/D conversion of the analog signal from a video printer etc. was

expressed by brightness Y and the color difference RY and BY. Here, they are RY=R-Y and BY=B-Y. Since the amount of data processing will increase if this image is used for a backlight judging and a person judging as it is, in the block information acquisition section 102, block division of the screen is carried out in all directions, and it is used for a judgment by making only central value in each block into block information. Block information is (1) average value. Average-value (2) WP value of the color in each block Color (3) BP value in the pixel (part) which is the max of the brightness Y within each block It consists of three kinds of color information on the color in the pixel (part) which is the min of the brightness Y within each block, and each is expressed by brightness Y and the color difference RY and BY. It can be said that this information includes both the color distribution information within a block, and gradation information. For example, even when it is beige, when [same as a color] the whole of 1 block is a "poor color" like a plaster wall, all of three kinds of information are in agreement, but by concavo-convex body like human being's face, since it has shading in a block, generally in three kinds of flesh colors, difference WP becomes, and most of most of highlights and BP becomes black. Thus, block information has a certain amount of gradation information, although resolution information is falling.

[0013] Moreover, although this example has not described, AGC (automatic gain control) processing which is the white balance amendment processing and the standard brightness amendment whose block information of this removes the effect by the lighting of a photographic subject shall already be carried out.

[0014] Next, the detail of the backlight judging section 103 is explained using drawing 2 . Drawing 2 is the block schematics of the backlight judging section 103 which is an important section of the gradation compensator in one example of this invention. First, the judgment policy of a reverse optical image is explained. By this example, I think "the difference of a reverse optical image and a follow light image is in the distribution pattern of shading within an image." A shading block since the illumination light was projected from the transverse plane of a photographic subject in the state of the follow light, when a block average image expresses an image inclines toward the whole image, and exists sparsely [there is nothing and]. In a reverse optical image, since the illumination light is projected from the upper part or a tooth back to a photographic subject, a shading block exists in the lower part of an image as a lump, or applies and exists in the lower part from the upper part of an image. We decided to judge a backlight using two (brightness and configuration), the brightness of this shading block, and a lump pattern. When there were two persons in a backlight condition, for a certain reason, that the center of an image becomes bright did not use the assumption that there was shading in the center of an image, by this technique, either. In consideration of all of three conditions of a dark space average luminance value, the brightness ratio of a bright section/dark space, and the configuration of dark space, a backlight judging is carried out after judging the block which is shading (dark space) by threshold processing of brightness according to this policy, mainly using the average luminance of block information.

[0015] In drawing 2 , the input image block information 201 is an image made from a block average color among three kinds of information on said block information, and average luminance and an average chromaticity are computed for every block. The average value of the average luminance of a whole block is calculated with the image average luminance count means 202, binarization of the image is carried out and it is classified into two kinds of blocks, dark space and a bright section, according to the light-and-darkness block brightness processing means 203. The example of the above processing is shown in drawing 3 . Drawing 3 (a) is a color picture inputted, and is the bust shot of the person of a backlight in this case. Drawing 3 (b) shows the average luminance image among the block average color images which divided the screen into 7 blocks long (x directions) and 10 blocks wide (the direction of y) a total of 70 blocks, and were acquired, and if it carries out binarization of this by the average of the whole brightness of each block, it will become like drawing 3 (c). The form of the person of a backlight part is mostly equivalent to dark space. Here, it is two-dimensional array about a block average luminance image and a binarization image, respectively. AV_YY [x], [y], and dark_tbl [x] and [y] When it expresses by carrying out, average mean_y of the average luminance of a whole block is [0016].

[Equation 1]

$$mean\_y = \frac{1}{70} \sum_{x=0}^{9} \sum_{y=0}^{6} AV\_YY[x][y]$$

[0017] Come out, it is and binarization image creation is a bright section. if AV_YY [x] and [y] > mean_ythen dark_tbl [x] and [y] = 0 dark space if AV_YY [x] and [y] < mean_ythen dark_tbl [x] and [y] = it is carried out by 1. Next, similarly with the light-and-darkness block brightness processing means 203, it is (1) dark-space average luminance. dark_mean, (2) bright-section average luminance light_mean, (3) light-and-darkness brightness ratio LDratio It is calculated.

[0018]

[Equation 2]

$$dark\_mean=\frac{1}{dark\_large}\sum_{x=0}^{9}\sum_{y=0}^{6} AV\_YY[x][y] \quad (for\ x, y:dark\_tbl[x][y]==1)$$

[0019]

[Equation 3]

$$light\_mean=\frac{1}{70-dark\_large}\sum_{x=0}^{9}\sum_{y=0}^{6} AV\_YY[x][y] \quad (for\ x, y:dark\_tbl[x][y]==0)$$

[0020]

[Equation 4]

$$LD\_ratio=light\_mean/dark\_mean$$

[0021] It is a dark space block total here. dark_large It carries out. The dark space block saturation processing means 204 is introduced in order that the backgrounds (green [of a crest], wooden green, etc.) that saturation and brightness are comparatively high may solve the problem which forms the dark space of a binarization image in the condition of having connected with the person photographic subject of a front backlight condition, when the person of a backlight is photoed. The content of processing is re--binarization-leaving only the monochrome field section with low saturation which is dark space only for dark space as a binary picture with average saturation for a binarization image. However, the re-binarization by saturation processing is not effective about all images, and in the backlight field of monochrome with saturation low from the first, since it carries out re-binarization of the monochrome field of almost same extent using **** kana saturation fluctuation, it becomes an opposite effect. Moreover, by the reverse Mitsuto object image by which saturation wears high dress with low brightness, since all dress parts are no longer a backlight field, only a face will be separated and a typical backlight pattern will be destroyed. For this reason, it asks for the average saturation in dark space first, and re-binarization is not carried out, when that average saturation is very low or very high. The concrete procedure is as follows.

(1) Calculate the square saturation average (dark_mean_s) within dark space.

[0022]

[Equation 5]

$$dark\_mean\_s=\frac{1}{dark\_large}\times\sum_{x=0}^{9}\sum_{y=0}^{6}(AV\_RY[x][y])^2\times(AV\_BY[x][y])^2 \quad (for\ x, y:dark\_tbl[x][y]==1)$$

[0023] (2) The value of dark_mean_s is a threshold. Since saturation is high enough when larger than S1 (S_CHECK=1), binarization is not carried out.

(3) The value of dark_mean_s is a threshold. Since saturation is low enough when smaller than S2 (S_CHECK=2), binarization is not carried out.

(4) The value of dark_mean_s Re-binarization is performed when it is in the medium of S1 S2 (S_CHECK=0). Re-binarization if (AV_RY [x], [y]) 2x(AV_BY [x], [y])2 < dark_mean_s then dark_tbl [x] and [y] = it is carried out as 0. Four circumference descriptions of dark space are calculated with the dark space block configuration processing means 205. As mentioned above, the photographic subject of a backlight has on the screen the shape facility generated from the lower part, applying to the upper part as a lump of shading. Then, binarization processing of the image is carried out, the number of continuation of a black block is added in each side direction until a black block disappears from the side around four four directions for the first time, and four circumference descriptions (Peripheral Characteristics) are searched for. Dark space's configuration and location of a lump within an image are expressed by performing ranking attachment of the value of the circumference description from the 1st place to the 4th place. An art is explained using drawing 4 . Drawing 4 is the conceptual diagram of the example of dark space block configuration processing. In drawing 4, by making the upper left into a zero, width is made into a x axis and length is made into the y-axis, and it divides into ten pieces in the x directions, and divides into seven blocks in the direction of y. Moreover, the direction of [from the right-hand side of an image] is made into the (3) directions from the (0) directions, the (1) from left part

direction, the (2) from top chord direction, and the lower side. The circumference description is an amount obtained by accumulating the black block which continues toward an opposite direction from these four directions, and adding on the side. These amounts It is accumulated in periph [3] from periph [0].

[0024]

[Equation 6]

$$periph[0] = \sum_{y=0}^{6} S0(y)$$

[0025]

[Equation 7]

$$periph[1] = \sum_{y=0}^{6} S1(y)$$

[0026]

[Equation 8]

$$periph[2] = \sum_{x=0}^{9} S2(x)$$

[0027]

[Equation 9]

$$periph[3] = \sum_{x=0}^{9} S3(x)$$

[0028] How to calculate S0, S1, S2, and S3 here is explained using drawing 5 . Drawing 5 is the flow chart of dark space block configuration processing. Since S0 to S3 is calculated by the same processing, it explains only S0 about the case of y= 0. In drawing 5 , it sets with S0=0, y= 0, and x= 9 first (step (**) of drawing 5 , (**)), and if x is not 0, it will judge whether it is dark_tbl[x] [y] =1 (a step (Ha), (**)). Processing is ended if it is dark_tbl[x] [y] =0. If it is dark_tbl [x] [y] =1, S0 is increased one (step (**)), x is reduced by one (step (**)), and x returns to the judgment of being zero or more again. Processing is ended if it is x= 0 (step (**)). This processing is performed from y= 0 to y= 6, and the sum is taken. If it says in the example of drawing 4 , the circumference information on the following dark space blocks will be acquired.

[0029] periph[0] =17periph[1] =14periph [2] Direction by which gave sequence by size relation and ranking attachment was carried out from order [0] in the dark space circumference information periph [0] to periph [3] at order [3] with the =0periph[3] =37 dark-space block circumference information sorting means 206 0, 1, 2, and 3 It sets. At the example of drawing 4 , circumference information is 37, 17, 14, and 0 to descending. Since it becomes, when the direction is set, it is order[0] =3 (down).

order[1] =0 (right)

order[2] =1 (left)

order[3] =2 (above)

It becomes. This order relation is simplified from the direction where size-related is large, and it is expressed as (3 0 1 2) as pattern configuration information on four directions. This pattern information 212 means the location configuration information "apply to the right part from the lower part of an image, there is dark space, and it does not exist in the upper part."

[0030] The backlight last judging means 207 is the dark space average luminance from the light-and-darkness block brightness processing means 203. dark_mean Light-and-darkness brightness ratio LDratio Two information 211 is acquired and the dark space pattern configuration information 212 is acquired from the dark space block circumference information sorting means 206. and the brightness ratio of thing (dark_mean <= dark_mean_t) (2) ** / dark with (1) dark-space average luminance value darker than light-and-darkness threshold dark_mean_t -- brightness ratio threshold Configuration pattern of larger thing (LDratio >= LD_t) (3) dark space than LD_t (3 x x x) Or (2 3 x x) it is .

When fulfilling three conditions to say simultaneously, in not fulfilling "it is a backlight" and any one condition, it judges the existence of a backlight as "not being a backlight." It is shown here that x is arbitrary. That is, the dark space configuration makes the backlight the case where 3 (below) is large at the case where three (below) directions are the largest patterns, and the degree of 2 (above). The former is equivalent to the most common person's backlight bust shot,

and, in the face rise of a person's backlight etc., the latter corresponds. This serves as the backlight existence judging 108.

[0031] Next, with the dark space block center-of-gravity processing means 208, the center of gravity of dark space is searched for for presumption of a next person face location. On the backlight scene, the dark part of this side other than a photographic subject has been reflected to ******** to the edge of right and left of an image by what it should be careful of in center-of-gravity processing, it is this effect, and the center-of-gravity location as the whole dark space is the point which shifts to right and left greatly. Then, the block of x= 0 and x= 9 which is 1 block of the edge of right and left of an image of dark space is excepted, and carries out center-of-gravity count using the blocks from 1 to 8 about x directions. a center-of-gravity location -- a block coordinate (x y) -- ** (gcenterX, gcenterY) -- if it carries out -- [0032]

[Equation 10]

$$gcenterX = \frac{1}{dark\_large} \sum_{x=1}^{8} \sum_{y=0}^{6} x$$

(for x:dark_tbl[x][y]=1)

[0033]

[Equation 11]

$$gcenterY = \frac{1}{dark\_large} \sum_{x=1}^{8} \sum_{y=0}^{6} y$$

(for y:dark_tbl[x][y]=1)

[0034] It becomes. Next, the inside-and-outside judging of the dark space of the center of gravity for using for location presumption at the time of backlight degree count of a person's face section is performed. When a center of gravity is located in the interior of dark space, it can presume that distribution of dark space is concentrating and the photographic subject of a backlight exists in a crest type centering on an image. On the other hand, when a center of gravity is out of dark space, it can presume that the photographic subject of a backlight is presenting the crest type bimodal in dark space by two persons. the time of this information expressing the block of a center-of-gravity location like drawing 8 -- G... a center of gravity -- the interior of dark space -- existence g... a center of gravity -- the dark space exterior -- existence -- like -- a case -- dividing -- carrying out -- displaying -- having .

[0035] A backlight degree is calculated with the dark space block person face brightness processing means 209. Actually, although it thought that the average luminance of dark space became the index of a degree simply at the beginning, although a person's face was dark, since dress was white, average luminance may be large and its judgment did not correspond with subjectivity assessment. Then, it decided to learn from subjectivity assessment of human being and to make the brightness of a person's face into an index. as for a cover, beige retrieval cannot be used for retrieval of a face by the retrieval equally using [it is alike and] a color which the face of the person in a backlight condition is shade, and colour information does not have However, since it is the description that the person exists in backlight circles, a reverse optical image should presume a face location only inside dark space on the basis of the center-of-gravity location of dark space. under the present circumstances, three kinds which consider the result of dark space block circumference information sorting processing, and show the configuration of dark space below -- a case -- dividing -- carrying out -- each of that **** -- the location of person **** -- assuming -- average luminance facelight It computes. Hereafter, the calculation approach of facelight is explained using drawing 6 which is the conceptual diagram of the example of dark space block person **** presumption. It is the block count by which the part in which the shading part was presumed to be a person's face within the dark space block in the dark space block is shown by the amount of Kurobe, and it was judged to be a person's face part in drawing 6 face_num It carries out. The case where 1st a dark space center of gravity is out of dark space with reference to drawing 6 (a) is explained. Since dark space is presenting the bimodal form, the center-of-gravity block g exists near the trough of dark space outside, and it is thought that there are two or more persons in a backlight condition. At this time, the "whole" dark space above a center-of-gravity location is considered to be two persons' face, and it asks for average luminance.

[0036]

[Equation 12]

$$facelight = \frac{1}{face\_num} \times \sum_{x=0}^{9} \sum_{y=0}^{gcenterY-1} AV\_YY[x][y] \quad (for\ x, y:dark\_tbl[x][y]=1$$

[0037] With reference to drawing 6 (b), a dark space center of gravity explains [2nd] the case (however, X shows arbitration) where the inside of dark space and a dark space configuration are (2 3 X X). This is the case where dark space applies and exists in the lower part from the upper part of an image, and when the person of a backlight was photoed by the rise, when distant view parts, such as woods, are in the background which hits the upper part of a reverse Mitsuto object, it corresponds. Since a little bright brightness of a distant view part may be taken if the upper part of dark space is considered to be a face at this time, it is the lower part [location / "center-of-gravity], and dark space" inside the rectangle region for 3 blocks of right and left of a center of gravity is considered to be a person's face, and it asks for average luminance.

[0038]

[Equation 13]

$$facelight=\frac{1}{face\_num}\sum_{x=gcenterX-1}^{gcenterX+1}\sum_{y=gcenterY+1}^{6}AV\_YY[x][y]$$

(for x, y: dark_tbl[x][y]=1)

[0039] With reference to drawing 6 (c), a dark space center of gravity explains [3rd] the case where the inside of dark space and a dark space configuration are (3 X X X). This is the case where dark space exists in the lower part of an image, and is a standard case at the time of carrying out bust shot photography of the reverse Mitsuto object. In this case, it will be greatly influenced by whether possibility that a person's "dress" exists in the lower part of dark space is high, and the color of average luminance of dress is black, or it is white. Then, in order to avoid this, it is the upper part [location / "center-of-gravity], and dark space" inside the rectangle region for 3 blocks of right and left of a center of gravity is considered to be a person's face, and it asks for average luminance.

[0040]

[Equation 14]

$$facelight=\frac{1}{face\_num}\sum_{x=gcenterX-1}^{gcenterX+1}\sum_{y=0}^{gcenterY-1}AV\_YY[x][y]$$

(for x, y: dark_tbl[x][y]=1)

[0041] One may not have a dark block in the face candidate field determined from the dark space center of gravity (face_num ==0). For example, (1) center of gravity is out of dark space, candidate [****] block count =0 (2) center of gravity is in dark space, and it is configuration pattern =2xxx 3xxx. It is the case of an except and is **** average luminance in this case. facelight is maximum. It is referred to as 255. For reverse luminous intensity, with the backlight degree count means 210, **** brightness is a light-and-darkness threshold. dark_mean_t It compares and let it be an assessment value (0-255) how dark to be. Moreover, **** brightness in the case of taking the maximum 255 of reverse luminous intensity most_dark It normalizes by deciding. Namely, [0042]

[Equation 15]

逆行度(gyakkodo) =

$$\frac{[(dark\_mean\_t)-(facelight)]}{[(dark\_mean\_t)-(most\_dark)]}\times 255$$

[0043] facelight When reverse luminous intensity, such as 255, becomes negative, reverse luminous intensity is set to 0. This serves as the backlight degree 110.

[0044] Next, the detail of the person judging section 104 is explained using drawing 7 . Drawing 7 is the block schematics of the person judging section 104 which is an important section of the gradation compensator of one example of this invention. The judgment policy of a portrait image is explained first.

[0045] Although beige detection of a face etc. is used for detection of a person like the conventional technique, not only a chromaticity but the description of gradation information is very important for a complexion. By a person's face, flesh color has bright shading, and most of a nose, a cheek, a frame, etc. is the flesh color like ****** at white. Are most

openings, such as hair, an eye, a hole of a nose, and opening, ** on the other hand at black? This means that a near part can detect as a WP value and flesh color with a near part overall as a BP value can detect as the average black white in each block in block information. Since white and black with low saturation, and flesh color with high saturation exist, when these are plotted on a chromaticity diagram, by the beige image, there is an inclination for the highlights section of gradation, the average, and the dark section to form the same hue line. However, with a wall with the cream system of the same hue, it is a uniform color, and in order for there to be no shading not much, a clear hue line is not formed on a chromaticity diagram. Moreover, in the red which is the same beige hue, since the saturation of the dark section is high, it is clearly distinguishable. Suppose that each information of all on WP value, BP value, and the average is plotted on a chromaticity diagram in each block of an image by this invention from the above consideration, a hue line is statistically extracted using a principal-component-analysis method, and it detects appropriate for flesh color. The hue line by principal component analysis is detected only using the sample data which exists in the second quadrant of (1) simple chromaticity diagram in case this count is performed, (2) Even when parallel translation has been carried out without a hue line passing by effect of the illumination light along a zero, it enables it to calculate almost correctly the include angle which the whole data distribution makes by detecting in two steps of the include angle of the detected hue line being in the range of pi/4 to pi with a simple chromaticity diagram.

[0046] In drawing 7 , the block information which processes the input image block information 201 and exists in the hue include angle appropriate for flesh color is chosen with the beige candidate block selection means 301. Unless it performs this candidate block ****, the result which will contain, will carry out statistics processing to a color completely unrelated to flesh color, and is meaningful is not searched for. Then, the assumption of "existing in the range from the yellow hue of RGB space to a red hue even if flesh color receives lighting fluctuation" is carried out, and a simple color difference (R-G) (B-G) chromaticity diagram (color moment diagram) is used as a chromaticity diagram. Since the hue from the yellow in the hue defined by the simple color difference chromaticity diagram in a RGB color space to red is equivalent to a second quadrant, the judgment of a candidate block has the advantage it becomes unnecessary for a simple positive/negative judging to be sufficient as and to carry out include-angle count. Therefore, by subsequent explanation, RY is R-G and BY is B-G. It becomes the semantics to say. Signs that the hue line 901 was expressed on the simple color difference chromaticity diagram were drawn on drawing 8 . The flesh color photoed outdoors like this example exists in the 2nd quadrant from yellow to red in a simple chromaticity diagram in many cases.

[0047] Then, candidate block selection does not give conditions about BP value, but both WP value and the average use existing in the 2nd quadrant in simple chromaticity color difference drawing of drawing 8 . Anew what changed into the simple color difference (Y, R-G, B-G) the block information currently expressed in original (Y, RY=R-Y, BY=B-Y) (1) average An AV_YY[x] [y] AV_RY[x] [y] AV_BY[x] [y] (2) WP value A WP_YY[x] [y] WP_RY[x] [y] WP_BY[x] [y] (3) BP value If BP_YY [x], [y], BP_RY [x] and [y], and BP_BY [x] and [y], in order to make into a candidate only the block which exists in the 2nd quadrant of the simple color difference chromaticity diagram shown in drawing 8 , it is a candidate block table. Zin_tbl [x] and [y] are used. if () WP_RY [x] and [y] >= 0 WP_BY [x] and [y] <= 0 AV_RY [x] and [y] >= 0 AV_BY [x] and [y] <= 0 then Zin_tbl [x] and [y] = 1 else Zin_tbl [x] and [y] = it is referred to as 0.

```
if (
        WP_RY[x][y] < sikido_max
        WP_BY[x][y] < sikido_max
)then
        Zin_tbl[x][y] = 1
else
        Zin_tbl[x][y] = 0
```

The saturation of WP value is not extremely large as another condition.

******** which it has. It does in this way. It is the beige candidate block count detected as Zin_tbl[x] [y] ==1 hada_num It carries out. With the covariance-matrix count means 302, three kinds of block information of WP value within a beige candidate block, BP value, and an average value is used, and statistics of color distribution is searched for using the gradation information within these blocks. The statistics technique performs count of WP, BP, the average of each average whole chromaticity, a variance, and a covariance value about a beige candidate block in order to use the principal-component-analysis technique which asks for the first characteristic vector from a covariance matrix. The average of RY and BY ry_av and by_av It asks by the following formulas. however, the sum -- Zin_tbl [x] and [y] it is = 1 -- all -- x and y ******** -- it shall take

[0048]

[Equation 16]

$$ry\_av = \frac{\sum_{x,y} WP\_RY[x][y] + \sum_{x,y} BP\_RY[x][y] + \sum_{x,y} AV\_RY[x][y]}{3 \times hada\_num}$$

[0049]

[Equation 17]

$$by\_av = \frac{\sum_{x,y} WP\_BY[x][y] + \sum_{x,y} BP\_BY[x][y] + \sum_{x,y} AV\_BY[x][y]}{3 \times hada\_num}$$

[0050] Here hada_num It is the number of beige candidate blocks, and 3 x hada_num is a total chromaticity measurement size. The variances Srr and Sbb of RY and BY and the covariance value Srb are calculated by the following formulas. the same -- the sum -- Zin_tbl [x] and [y] it is =1 -- all -- x and y ******** -- it shall take

[0051]

[Equation 18]

$$Srr = \sum_{x,y} (WP\_RY[x][y] - ry\_av)^2 + \sum_{x,y} (BP\_RY[x][y] - ry\_av)^2 + \sum_{x,y} (AV\_RY[x][y] - ry\_av)^2$$

[0052]

[Equation 19]

$$Sbb = \sum_{x,y} (WP\_BY[x][y] - by\_av)^2 + \sum_{x,y} (BP\_BY[x][y] - by\_av)^2 + \sum_{x,y} (AV\_BY[x][y] - by\_av)^2$$

[0053]

[Equation 20]

$$Srb = \sum_{x,y} (WP\_RY[x][y] - ry\_av) \times (WP\_BY[x][y] - by\_av) + \sum_{x,y} (BP\_RY[x][y] - ry\_av) \times (BP\_BY[x][y] - by\_av) + \sum_{x,y} (AV\_RY[x][y] - ry\_av) \times (AV\_BY[x][y] - by\_av)$$

[0054] Consequently, with the covariance-matrix count means 302, it is a matrix [0055].

[Equation 21]

$$S = \begin{bmatrix} Srr & Srb \\ Srb & Sbb \end{bmatrix}$$

[0056] It ******. Next, with the beige hue line detection means 303, a beige hue line is calculated as a characteristic vector with the first principal component shaft of this statistical distribution, i.e., the maximum eige nvalue. It is TanValue = tan 2theta, using the hue line which is specifically a principal component shaft, BY orthoaxis, and the include angle to make as theta [0057]

[Equation 22]

$$\tan 2\theta = \frac{2Srb}{(Sbb-Srr)}$$

[0058] It calculates with the becoming relational expression. For count simplification, it will not ask for theta directly but the value of TanValue will substitute for the beige hue line detection means 303.

[0059] Next with the beige hue angle existence region detection means 304, it determines [whether the hue angle theta of a beige line exists in ** useless ****** within the limits beforehand, and]. Although the many valued function nature of Tan-1 poses a problem here, this problem is solvable if the quadrant in which 2theta exists as follows is taken into consideration. the quadrant in which 2theta exists in drawing 10 which is principle drawing of an existence region judging of drawing 9 which is the conceptual diagram showing the existence region of beige hue angle 2theta, and a beige hue angle -- Srb >=0 and -- (Sbb-Srr) >=0 = > -- the 1st -- quadrant Srb >=0 and -- (Sbb-Srr) <0 => -- the 2nd -- quadrant Srb < 0 and -- (Sbb-Srr) <0 => -- the 3rd -- quadrant Srb < 0 and -- (Sbb-Srr) >=0 It is determined as the => 4th quadrant. In this invention, it is assumed that the range of the include angle theta of the detected beige hue line is from pi/4 shown in the slash range of a simple color difference chromaticity diagram as shown in drawing 8 to pi. therefore, the twice show 2theta to drawing 9 -- as -- pi/2 of tan 2theta from -- it is the range of 2pi. For this reason, although 2theta exists even in the 4th quadrant through the 3rd quadrant from the 2nd quadrant as shown by drawing 9 at an angle of the slash range, it cannot be in the 1st quadrant. Assignment of the include-angle range of theta can be transposed to threshold processing of TanValue = tan 2theta using this property. The relation between 2theta and tan2theta was shown in drawing 10 . What is necessary is just to determine thresholds TH1 and TH2 from here, since the linear nature and monodromy of tan2theta are maintained from the above-mentioned argument to a part of 2nd and 3rd quadrant and 4th quadrant in drawing 10 . The output of the beige hue angle existence region detection means 304 is . if (TanValue > TH1 or TanValue < TH2)
It is beige. else Suppose that it is not beige. If it is required to be TH1 > TH2 and this condition does not exist, monodromy stops however, materializing.

[0060] With the beige candidate block center-of-gravity processing means 305, the center of gravity of the location of a beige candidate block is calculated. This processing is introduced for threshold processing of the center-of-gravity location for preventing the incorrect judging of a field similar to flesh colors in the image lower part, such as a "desk" and a "ground surface", as a color. a center-of-gravity location -- a block coordinate (x y) -- ** (hada_gcenterX, hada_gcenterY) -- if it carries out -- [0061]

[Equation 23]

$$hada\_gcenterX = \frac{1}{hada\_num} \sum_{x=1}^{8} \sum_{y=0}^{6} x$$

(for x:Zin_tbl[x][y]=1)

[0062]

[Equation 24]

$$hada\_gcenterY = \frac{1}{hada\_num} \sum_{x=1}^{8} \sum_{y=0}^{6} y$$

(for y:Zin_tbl[x][y]=1)

[0063] It becomes. With the person last judging processing means 306, the last judging of whether an input image is a portrait image or there is nothing is carried out by the following criteria. That is, it goes into either of the range whose outputs from (1) beige hue angle existence region detection means 304 are following three.

[0064]
(a) 2theta -- the 2nd quadrant -- it is -- and -- TanValue > TH1 (b)2theta is in the 3rd quadrant. (c)2theta -- the 4th quadrant it is -- and -- TanValue -- < -- th2 The output from the (2) beige candidate block center-of-gravity processing means 305 is in the following range.
[0065] hada_gcenterY -- < -- Suppose that it is not a person photography scene other than [its] being a person photography scene when fulfilling two conditions of hada_gcenter_max (that is, the screen top Y coordinate of a beige center of gravity is up by the image from the 4th block.) both. This serves as the person existence judging 109 in the person judging section 104.
[0066] Brightness with the average of a beige candidate block beige in order to ask for a person degree with the beige brightness processing means 307 hada_Y is calculated. Array The average of (highlights brightness value) + (average luminance value) is calculated only about the block whose Zin_tbl [][] is 1. [of a beige candidate]
[0067]
[Equation 25]

$$hada\_Y = \frac{1}{2 \times hada\_num} \sum_{x=0}^{9} \sum_{y=0}^{6} \{(WP\_YY[x][y]) + (AV\_YY[x][y])\}$$

(for x, y : Zin_tbl [x][y] == 1)

[0068] the person degree count means 308 -- "darkest beige brightness" the "skin brightness" which can obtain hada_most_dark and "brightest beige brightness" hada_most_light from an image-processing experiment -- reference -- carrying out -- deciding -- hada_Y hada_most_dark hada_most_light It normalizes in between.
[0069]
[Equation 26]

$$\text{入物度(Zinbutsudo)} = \frac{[(hada\_most\_light) - (hada\_Y)]}{[(hada\_most\_light) - (hada\_most\_dark)]} \times 255$$

[0070] Person existence decision is NO. It ****s to =0 whenever [person] at the case. This serves as the person degree 111.
[0071] Next, the detail of the categorization section 105 and the scene information decision section 106 is explained. An input image is classified into one category in four categories of "the backlight YES person YES", the "backlight YES person NO", the "backlight NO person YES", and the "backlight NO person NO" according to the categorization section 105 combining two information, the backlight existence judging 108 and the person existence judging 110. In the scene information decision section 106, each reliability of three descriptions of the image scene "backlight scene" -"person photography scene" - "others" required at the time of composition of the amendment curve by gradation amendment is determined from the selected category information. The sum of reliability is 1. The method which determines the value of reliability for every category beforehand is taken. For example, if decision that an image belongs to the category of "the backlight YES person YES" is made, it will be constituted so that three sorts of reliability may be decided automatically, and count of reliability will not be performed for every image like a backlight degree or a person degree. Then, the prior processing which asks for the response relation between a category and reliability beforehand is needed.
[0072] Hereafter, prior processing is explained using drawing 11 which is the block schematics showing the prior processing for reliability count. In drawing 11 , the sample images 401 are many images used for prior processing. Label attachment of these images shall be beforehand carried out by subjectivity assessment of human being a "reverse optical image", "a portrait image" or, and "it being an image in addition to this" (scenery, a still life, etc. being collectively called "others").
[0073] Person existence judging means 104a is processed in the person judging section 104, and the person existence judging 109 is outputted at the same time it processes backlight existence judging means 103a in the backlight judging section 103 about each of this sample image and outputs the backlight existence judging 108. Automatic classification of the categorization section 105 is carried out to 22= 4 kinds of categories YES, i.e., a "backlight YES person", the "backlight YES person NO", the "backlight NO person YES", and the "backlight NO person NO" from the combination of the existence of two descriptions of this "backlight scene" and a "person photography scene." all sample images are shown in drawing 4 after processing -- as -- the category of "the backlight YES man YES" -- a total of N -- the image

with which the image sample of one example was classified and label attachment of the breakdown was carried out with the "reverse optical image" by subjectivity assessment -- G1 example -- the same -- "a portrait image" -- Z -- suppose that "it is an image in addition to this" was similarly one example A1 example. At this time, the reliability in the "backlight YES person YES" category is defined as follows respectively.

[0074]

[Equation 27]

$$\text{逆光信頼度} = \frac{G1}{N1} \qquad \text{人物信頼度} = \frac{Z1}{N1}$$

$$\text{その他信頼度} = \frac{A1}{N1} = \frac{N1-G1-Z1}{N1}$$

[0075] The reliability in the "backlight YES person NO" category is [0076] similarly.

[Equation 28]

$$\text{逆光信頼度} = \frac{G2}{N2} \qquad \text{人物信頼度} = \frac{Z2}{N2}$$

$$\text{その他信頼度} = \frac{A2}{N2} = \frac{N2-G2-Z2}{N2}$$

[0077] It becomes. The same is said of other categories. The scene information decision section 106 determines the reliability of an input image with the reliability of each description searched for by such prior processing. The gradation amendment section 107 generates a gradation amendment curve based on the backlight reliability and person reliability about an input image, the reliability information 112 of reliability in addition to this, and the backlight degree 110 and the person degree 111. Easy [of three kinds of forms, the gradation curve for backlight amendment, the gradation curve for person amendment, and the other gradation curves for amendment,] is carried out to the gradation amendment section 107. Generation of a gradation curve is performed in two steps. The amendment degree of the gradation curve for backlight amendment and the amendment degree of the gradation curve for person amendment are first adjusted based on the degree information of a backlight and a person. In addition, the gradation curve for amendment is determined regardless of a degree. Next, weighting composition of three kinds of generated curves is carried out for three kinds of reliability information on backlight reliability, person reliability, and other reliability, and the last curve is generated. The optimal gradation amendment curve according to an image scene is generable with the above actuation.

[0078]

[Effect of the Invention] In this invention, a backlight scene and a person scene are judged from the inputted image, and since a gradation amendment curve is generated the optimal according to the degree and reliability and gradation amendment can be performed, even when the quality of a former image is seldom high definition, a high-definition video print can be obtained.

[0079] In a backlight judging, in order to judge a backlight scene in the configuration and brightness of dark space, without using the assumption which exists in middle of the screen, the judgment of high degree of accuracy can do a backlight photographic subject conventionally, and a value reliable since person **** is presumed and evaluated also about a backlight degree can be acquired.

[0080] In a person judging, although a beige judging is made into the keynote, based on the candidate data from a chromaticity, beige distribution was searched for by the principal-component-analysis technique including beige gradation, the approach of judging at the include angle is taken, and it can detect, without being influenced of lighting fluctuation in comparison.

[Translation done.]

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CLAIMS

[Claim(s)]
[Claim 1] The block information acquisition section which carries out block division of the input image, and searches for brightness chromaticity information, A description existence judging means to judge the existence of said description for every description of said input image with the output of said block information acquisition section, A degree information decision means by which the image processing corresponding to said description determines the brightness degree of the specific part of said input image, The categorization section which classifies said input image according to the combination of the output of each of said description existence judging means to each category, The gradation compensator possessing the scene information decision section which determines with what reliability said input image has said each description for said each category of every, and the gradation amendment section which performs gradation amendment to said input image according to the output of said degree information decision means, and the output of said scene information decision section.
[Claim 2] A description existence judging means is the gradation compensator according to claim 1 which it has in an image average-luminance count means ask for the average luminance of the whole input image from the output of the block information acquisition section, the light-and-darkness block brightness processing means which carry out the binarization of said input image to a bright-section block and a dark-space block, a dark-space block configuration processing means process said dark-space block and output dark-space circumference information, and a dark-space block circumference information sorting processing means set in order said dark-space circumference information.
[Claim 3] An image average luminance count means by which the description existence judging means asks for the average luminance of the whole input image from the output of the block information acquisition section, The light-and-darkness block brightness processing means which carries out binarization of said input image to a bright section block and a dark space block, The dark space block saturation processing means which carries out binarization of said dark space block with saturation, The gradation compensator according to claim 1 which has a dark space block configuration processing means to process the output of said dark space block saturation processing means, and to output dark space circumference information, and a dark space block circumference information sorting processing means to set in order said dark space circumference information.
[Claim 4] An image average luminance count means by which a degree information decision means asks for the average luminance of the whole input image from the output of the block information acquisition section, A light-and-darkness block brightness processing means to carry out binarization of said input image to a bright section block and a dark space block, and to process it, A dark space block center-of-gravity processing means to process said dark space block and to output the center of gravity of said dark space block, The gradation compensator according to claim 1 which has a dark space block person face brightness processing means to presume the **** field of the person within a dark space block using the output of said dark space block center-of-gravity processing means, and to calculate the brightness.
[Claim 5] A description existence judging means is the gradation compensator according to claim 1 have a beige candidate block selection means processes the output of the block information acquisition section and choose a beige candidate block, a covariance-matrix count means perform statistics processing from the output of said beige candidate block selection means, a beige hue line detection means detect a beige hue line from the output of said covariance-matrix count means, and the beige hue angle existence region detection means detect the existence region of the hue angle of said beige hue line.
[Claim 6] A beige candidate block selection means for the description existence judging means to process the output of the block information acquisition section, and to choose a beige candidate block, A covariance-matrix count means to perform statistics processing from the output of said beige candidate block selection means, A beige hue line detection means to detect a beige hue line from the output of said covariance-matrix count means, The gradation compensator according to claim 1 which has a beige hue angle existence region detection means to detect the existence region of the

hue angle of said beige hue line, and a beige candidate block center-of-gravity processing means to process the output of said beige candidate block selection means, and to output the center of gravity of said beige candidate block.

[Claim 7] A degree information decision means is a gradation compensator according to claim 1 which has a beige candidate block selection means to process the output of the block information acquisition section and to choose a beige candidate block, and a beige brightness processing means to process said beige candidate block and to output beige brightness.

[Claim 8] The categorization section is a gradation compensator according to claim 1 which classifies [1st / 2nd] an input image into four that it is not not the 4th backlight that is not the 3rd backlight that is not a person photography scene although it is the backlight which is the person photography scene of a backlight but a person photography scene but a person photography scene, either according to the combination of the existence of the backlight scene description, and the existence of the person scene description.

[Claim 9] The scene information decision section is 2M from the combination of the existence of said description by the categorization section about the image sample of a large number by which label attachment was beforehand carried out by each one of the M descriptions Cm (m= 1 ... M). Automatic classification is carried out to an individual. nickel classified into the i-th the reliability of each description Cm of the image which made the measurement size Lm individual although label attachment was carried out in the description Cm among the image samples of an individual, and was classified into the i-th -- Lm/nickel ** -- gradation compensator according to claim 1 characterized by carrying out.

[Claim 10] The description of an input image is a gradation compensator according to claim 1 characterized by being three of the scenes are excluding a backlight scene to the 1st and excluding [description] said the 1st and 2 to the 2nd at the person photography scene 3rd.

[Claim 11] The block information acquisition section is a gradation compensator according to claim 1 characterized by dividing an input image into a block coarse in all directions, and acquiring the average of the brightness and chromaticity of the colors of all the pixels within a block for every block.

[Claim 12] The block information acquisition section is a gradation compensator according to claim 1 characterized by dividing an input image into a block coarse in all directions, specifying a pixel set for every block, and acquiring the average luminance and the average chromaticity within said pixel set whose brightness of a color is max about said all pixel sets within a block.

[Claim 13] The block information acquisition section is a gradation compensator according to claim 1 characterized by dividing an input image into a block coarse in all directions, specifying a pixel set for every block, and acquiring the average luminance and the average chromaticity within said pixel set whose brightness of a color is min about said all pixel sets within a block.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] Block schematics of the gradation compensator in one example of this invention
[Drawing 2] Block schematics showing the backlight judging section which is an important section of the gradation compensator of this example
[Drawing 3] The conceptual diagram showing the light-and-darkness block brightness processing in the gradation compensator of this example
[Drawing 4] The conceptual diagram showing the example of the dark space block configuration processing in the gradation compensator of this example
[Drawing 5] The processing flow chart of the dark space block configuration processing in the gradation compensator of this example
[Drawing 6] The conceptual diagram showing the example of dark space block person **** presumption in the gradation compensator of this example
[Drawing 7] Block schematics showing the person judging section which is an important section of the gradation compensator of this example
[Drawing 8] The simple color difference chromaticity diagram showing the range of the include angle theta of the beige hue line in the gradation compensator of this example
[Drawing 9] The conceptual diagram showing the existence region of beige hue angle 2theta in the gradation compensator of this example
[Drawing 10] Principle drawing of a judgment of the existence region of the beige hue angle in the gradation compensator of this example
[Drawing 11] Block schematics showing the prior processing for the reliability count in the gradation compensator of this example
[Description of Notations]
101 Input Image
102 Block Information Acquisition Section
103 Backlight Judging Section
103a Backlight existence judging means
103b Backlight degree information decision means
104 Person Judging Section
104a Person existence judging means
104b Person degree information decision means
105 Categorization Section
106 Scene Information Decision Section
107 Gradation Amendment Section
108 Backlight Existence Judging
109 Person Existence Judging
110 Backlight Degree Information
111 Person Degree Information
112 Reliability Information

[Translation done.]

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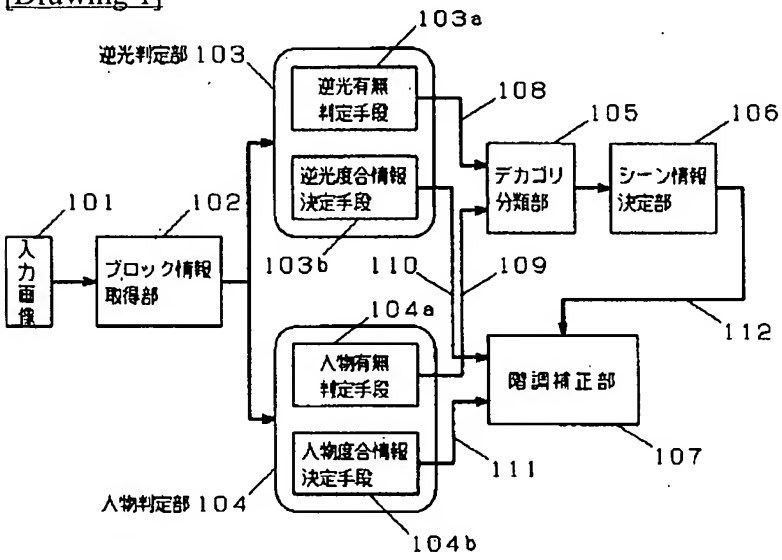
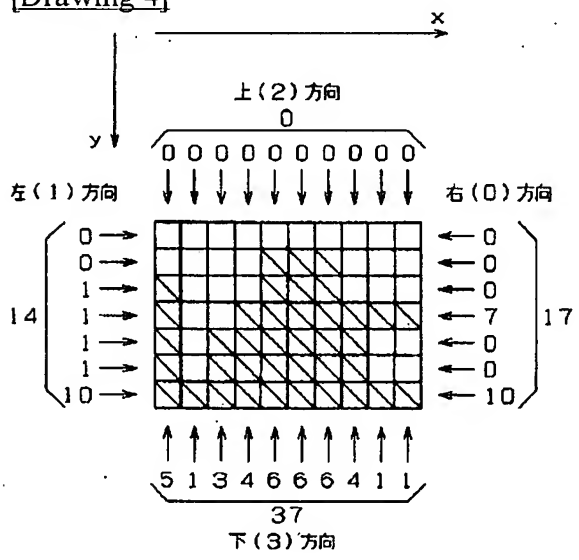
DRAWINGS

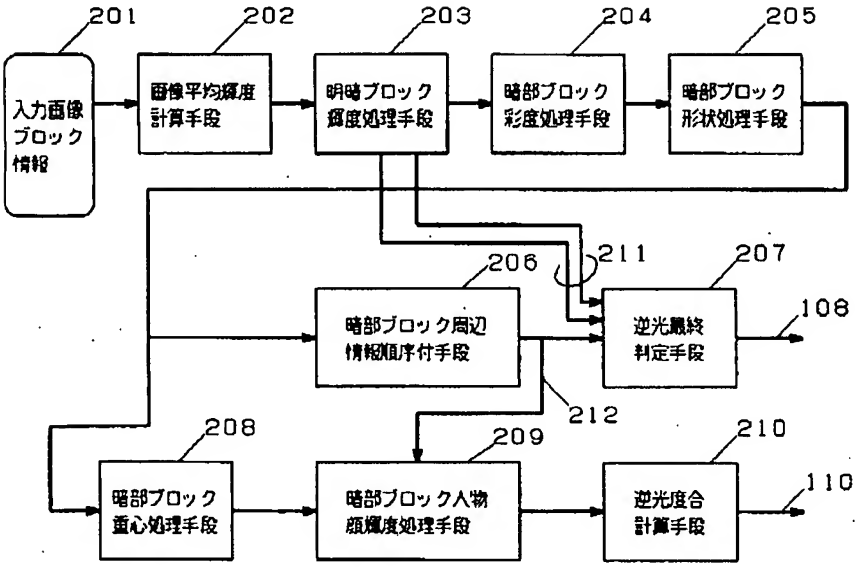
[Drawing 1]



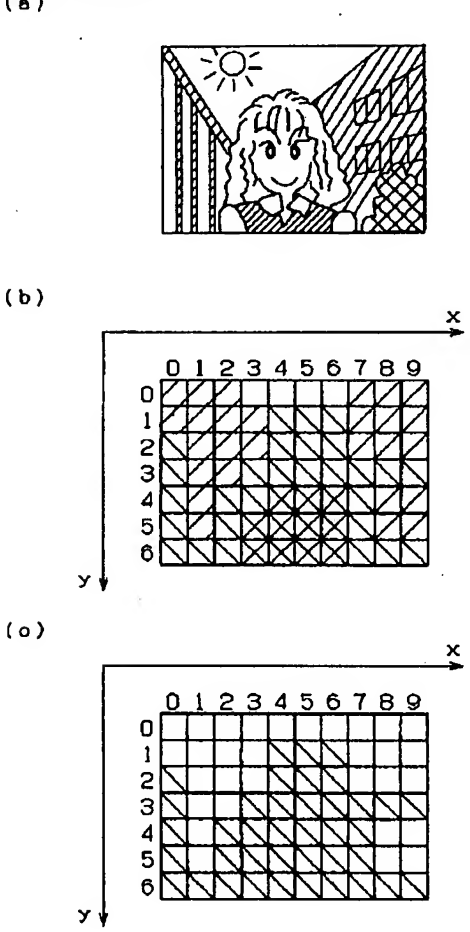
[Drawing 4]



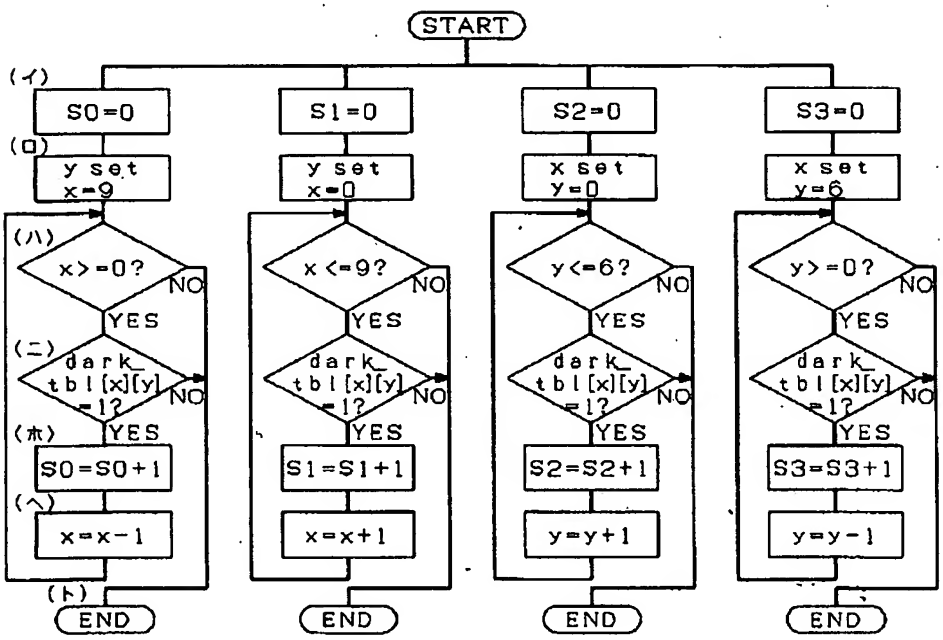
[Drawing 2]



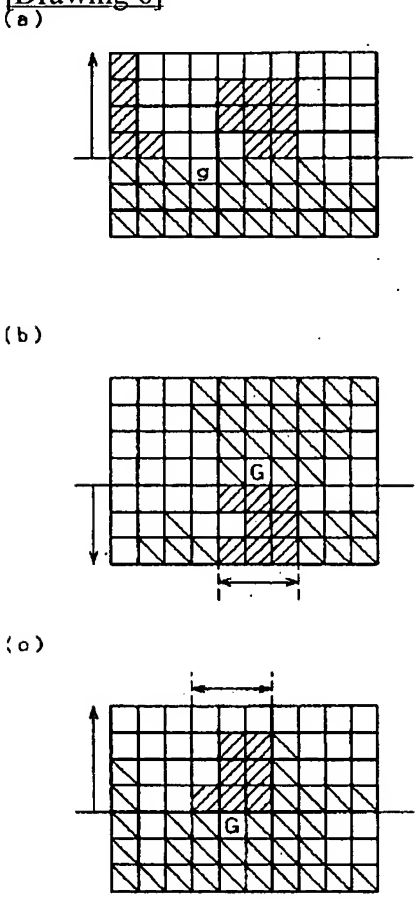
[Drawing 3]



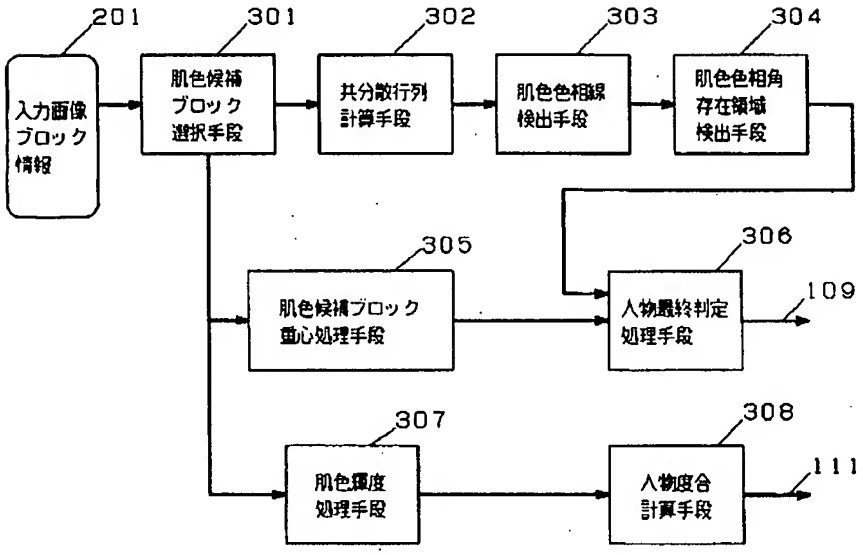
[Drawing 5]



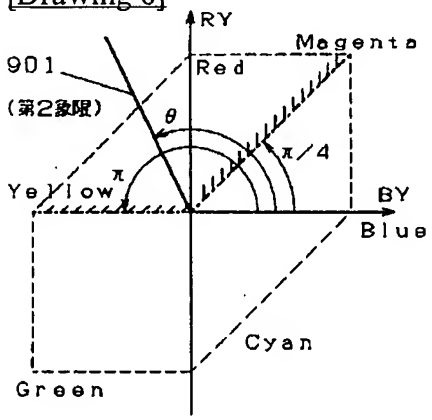
[Drawing 6]



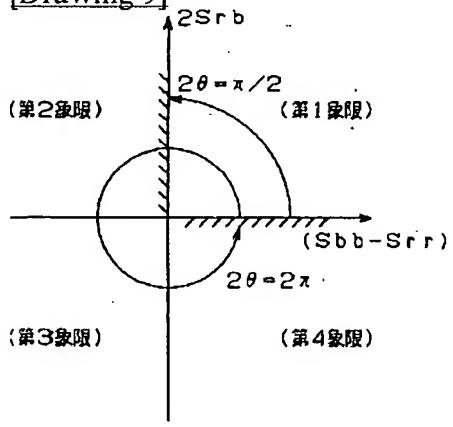
[Drawing 7]



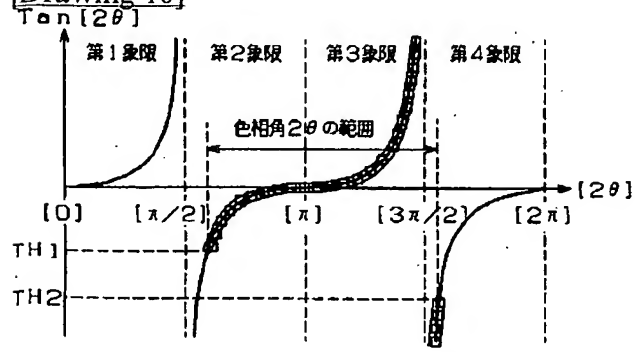
[Drawing 8]



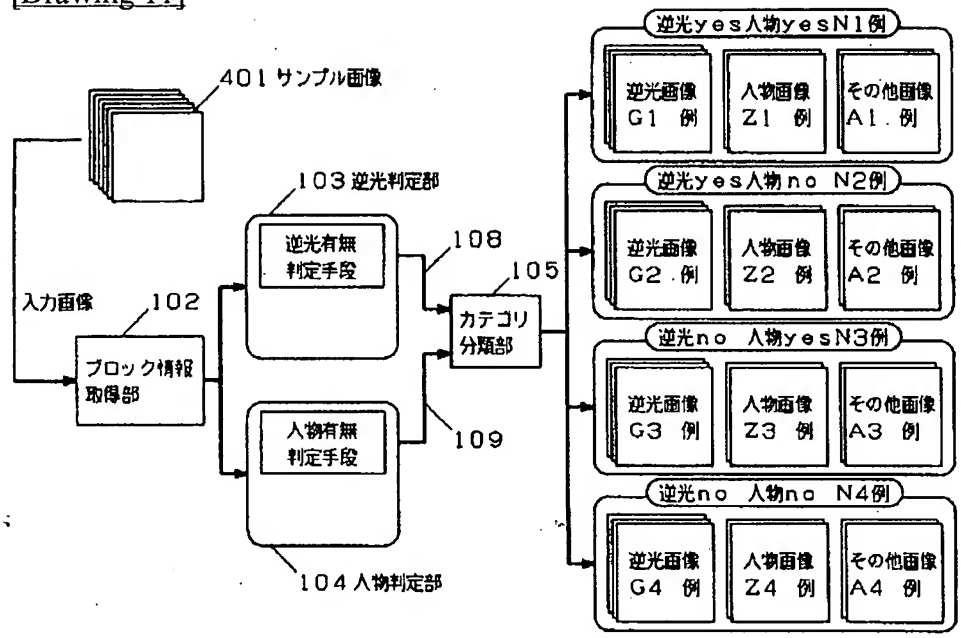
[Drawing 9]



[Drawing 10]



[Drawing 11]



[Translation done.]